

Revision of two holotypes of *Nanocladius* Kieffer (Diptera: Chironomidae), with a key to males from the East Asia

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Abstract: Two holotypes of the orthoclad genus *Nanocladius* from Japan were redescribed and illustrated: *Nanocladius* (*Plecopteracoluthus*) *asiaticus* Hayashi and *Nanocladius* (*Nanocladius*) *tamabicolor* Sasa. A key to the males of *Nanocladius* from the East Asia was provided.

Key words: chironomid midges; taxonomy; redescriptions

矮突摇蚊属两种正模的修订及东亚雄虫检索表（双翅目：摇蚊科）

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摘要: 通过对存放在日本自然科学博物馆的模式标本进行详细观察, 重新修订了矮突摇蚊属的 2 个种: *Nanocladius* (*Plecopteracoluthus*) *asiaticus* Hayashi 和 *Nanocladius* (*Nanocladius*) *tamabicolor* Sasa, 绘制了 2 个种的模式标本成虫特征图, 编制了东亚地区范围内该属的雄成虫分种检索表。

关键词: 摇蚊; 分类; 重新描述

Introduction

Nanocladius was erected with its type species, *Nanocladius vitellinus* (Kieffer 1913). The genus includes two subgenera: *Nanocladius sensu stricto* and *Plecopteracoluthus* (Steffan 1965).

Until now, 35 confirmed species of the genus were recorded in the world, including 17 species in the Palaearctic Region, five in the Oriental Region, 13 in the Nearctic Region, seven in the Afrotropical Region, and one in the Neotropical Region (Ashe & O'Connor 2012; Inoue *et al.* 2015). To date, a total of 20 *Nanocladius* species have been described or recorded from the East Asia, including six from China, seven from Japan, one from Korea, and two from Mongolia, nine from the Russian Far East, as detailed in Table 1 (Ashe & O'Connor 2012; Fu & Wang 2009; Inoue *et al.* 2015; Makarchenko *et al.* 2005).

Table 1. Males of *Nanocladius* Kieffer from East Asia

Region	Species
China	<i>N. (N.) baltus</i> , <i>N. (N.) calvatus</i> , <i>N. (N.) rectinervis</i> , <i>N. (N.) taiwanensis</i> , <i>N. (N.) trinus</i> , <i>N. (P.) asiaticus</i> (6 species)
Japan	<i>N. (N.) jintuquardecima</i> , <i>N. (N.) oyaberadiata</i> , <i>N. (N.) seiryufagea</i> , <i>N. (N.) tamabicolor</i> , <i>N. (N.) tokuokasia</i> , <i>N. (P.) asiaticus</i> , <i>N. (P.) shigaensis</i> (7 species)
Russian Far East	<i>N. (N.) balticus</i> , <i>N. (N.) crassicornus</i> , <i>N. (N.) distinctus</i> , <i>N. (N.) minimus</i> , <i>N. (N.) palpideminutus</i> , <i>N. (N.) pubescens</i> , <i>N. (N.) tamabicolor</i> , <i>N. (N.) spiniplenus</i> , <i>N. (P.) asiaticus</i> (9 species)
Korea	<i>N. (N.) tamabicolor</i> (1 species)
Mongolia	<i>N. (N.) dichromus</i> ; <i>N. (N.) rectinervis</i> (2 species)

According to references, seven species were described from Japan, including two species in the subgenus *Psilocricotopus*: *N. (P.) asiaticus* Hayashi, 1998, *N. (P.) shigaensis* Inoue *et al.*, 2015, and five species from the subgenus *Nanocladius sensu stricto*: *N. (N.) jintuquardecima* (Sasa, 1996), *N. (N.) oyaberadiata* (Sasa *et al.*, 1988), *N. (N.) tamabicolor* Sasa, 1981, *N. (N.) seiryufagea* Sasa *et al.*, 1998, *N. (N.) tokuokasia* Sasa, 1989 (Ashe & O'Connor 2012; Yamamoto 2004; Inoue *et al.* 2015). The original reports with figures about the species are too simple to be read their taxonomic information, or contained errors in their descriptions, when the current morphological nomenclature was not to be followed. To systematically study the genus, comprehensive and detailed descriptions and figures were provided based on careful observation of two holotypes after borrowed from Japan.

Material and methods

Morphological nomenclature follows Sæther (1980) with the additions and corrections given by Sæther (1990). Measurements of the different parts of the adults are expressed in µm except the total length of the adults and the wing length which are given in mm. In the figures of the male genitalia, the dorsal view is shown on the left, the ventral view on the right. The holotype specimen from Japan examined in this paper was loaned from the National Science Museum, Tokyo, Japan.

Taxonomy

Nanocladius Kieffer

Nanocladius Kieffer, 1913: 31. Type species: *Nanocladius vitellinus* Kieffer, 1913.

1. *Nanocladius (Plecopteracoluthus) asiaticus* Hayashi, 1998 (Figs. 1–5)

Nanocladius (Plecopteracoluthus) asiaticus Hayashi, 1998: 217; Makarchenko *et al.*, 2005: 404; Yamamoto, 2004: 55.

Paratrichocladius tusimobeceus Sasa and Suzuki, 1999: 80.

Specimen examined. Holotype of *Nanocladius (Plecopteracoluthus) asiaticus* Hayashi, male, Japan. 24-III-1998 (No. 354: 42), Suzuki.

Diagnostic characters. This species can be separated from other East Asian members of

the genus by AR 0.34; squama with 16 setae; inferior volsella developed, with right-angled corner and many strong setae.

Description. Total length 3.15 mm. Wing length 1.60 mm. Total length / wing length 2.0. Wing length/length of profemur 2.6.

Coloration. Thorax dark brown. Tergites brown. Legs brown.

Head. Antenna with 13 flagellomeres; ultimate flagellomere 155 μm long, AR 0.34. Temporal setae absent. Clypeus with 16 setae. Tentorium 165 μm long; 33 μm wide. Palpomeres lengths (in μm): 50, 58, 103, 165, 225. Palpomere 5/3 ratio: 2.2.

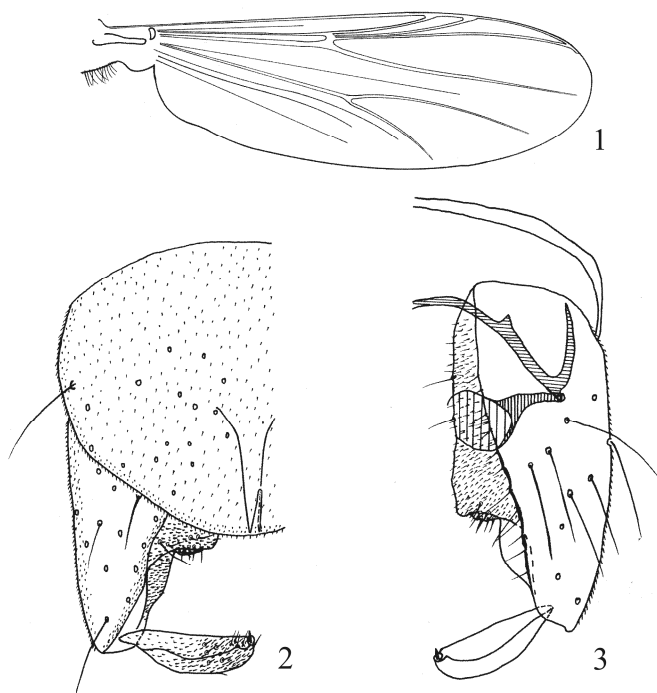
Wings (Fig. 1). VR 1.20. Cu length 720 μm . Squama with 16 setae. Cu / wing length 0.44. Wing width/wing length 0.36.

Thorax. Dorsocentrals 13, prealars 3. Scutellum with 14 setae.

Legs. Spur of foretibia 40 μm long; spurs of midtibia 23 μm and 20 μm long; of hind tibia 50 μm long. Width at apex of fore tibia 63 μm ; of mid tibia 58 μm ; of hind tibia 63 μm . Hind tibial comb with 11 setae. Lengths and proportions of legs as in Table 2.

Table 2. Lengths (in μm) and proportions of legs segments of holotype male *Nanocladius* (*Plecopteracoluthus*) *asiaticus* Hayashi

	Fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	BV	SV	BR
p ₁	620	760	460	305	220	140	105	0.61	3.0	2.4	1.0
p ₂	690	690	305	180	140	80	90	0.44	4.5	3.4	1.5
P3	650	760	390	225	185	90	95	0.51	3.6	3.0	1.6



Figures 1–3. *Nanocladius* (*Plecopteracoluthus*) *asiaticus* Hayashi, Male imago. 1. Wing; 2. Hypopygium, dorsal view; 3. Hypopygium, ventral view.

Hypopygium (Figs. 2, 3). Anal point bare with pointed apex, but the apex of anal point upcurved in holotype, without setae at base. Tergite IX with many setae, laterosternite IX with 3 setae. Phallapodeme 75 μm long; transverse sternapodeme 95 μm long, with small oral projections. Gonocoxite 208 μm long; with 8 long setae. Inferior volsella developed, bilayered, under-layer with many marginal setae. Gonostylus 93 μm long, with inner apical setae short setae and small protuberance basally. HR 2.2; HV 3.4.

Distribution. This species occurs in Japan and the Russian Far East (Palearctic Region).

Remarks. Based on the holotype, AR is only 0.34, while it is measured as 0.12–1.20 in the original description (Hayashi 1998). According to the references (Hayashi 1998; Inoue *et al.* 2015), this species lacks an anal point, actually an anal point exists and corrects the mistake in the previous reports (Figs. 4, 5).



Figures 4, 5. *Nanocladius (Plecopteracoluthus) asiaticus* Hayashi, Holotype. 4. Antenna; 5. Hypopygium (photograph by National Museum of Nature and Science, Tokyo, Japan).

2. *Nanocladius (Nanocladius) tamabicolor* Sasa, 1981 (Figs. 6–8)

Spaniotom (Eukiefferiella) bicolor (Zetterstedt, 1838): Tokunaga, 1938: 319.

Nanocladius seiryudeeus (Sasa, Suzuki & Sakai, 1998): Sæther, Ashe & Murry, 2000: 159.

Microcricotopus seoulensis Ree & Kim, 1981: 174.

Nanocladius (Nanocladius) seoulensis (Ree & Kim): Sasa, 1989: 46.

Nanocladius (Nanocladius) tamabicolor Sasa, 1981: 22; Sasa & Kawai, 1987: 41; Makarchenko *et al.*, 2001: 158; Makarchenko *et al.*, 2005: 404; Yamamoto, 2004: 54.

Rheosmittia nojirinigra Sasa, 1991: 85.

Specimen examined. Holotype of *Nanocladius (Nanocladius) tamabicolor* Sasa, male, Takao & Hachioji, Minamiasakawa River, Tokyo Metropolitan, Honshu, Japan. 23-VIII-1979 (No. 54: 01), Suzuki.

Diagnostic characters. This species can be separated from other East Asian members of this genus by inferior volsella with rounded margins and many setae, gonostylus apical

strongly hooked and with one long setae.

Description. Total length 1.53 mm. Wing length 0.98 mm. Total length / wing length 1.6. Wing length / length of profemur 2.9.

Coloration. Head dark brown. Thorax dark brown. Tergites dark brown. Legs brown.

Head. Antenna with 13 flagellomeres; ultimate flagellomere 260 μm long, AR 0.8. Temporal setae absent. Clypeus with 12 setae. Tentorium 138 μm long; 13 μm wide. Palpomeres length (in μm): –, 45; 68; 88; 118. Palpomere 5/3: 1.7.

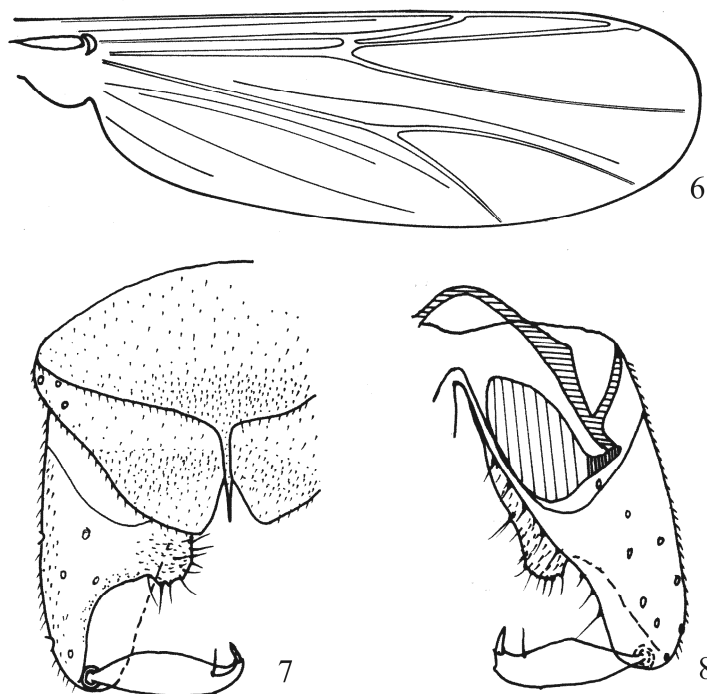
Wings (Fig. 6). VR 1.30. Cu length 480 μm . Squama without seta. Cu / wing length 0.49.

Thorax. Dorsocentrals 7. Scutellum with 2 setae.

Legs. Spurs of fore tibia 38 μm and 15 μm long; spurs of mid tibia 15 μm and 13 μm long; spurs of hind tibia 33 μm and 15 μm long. Width at apex of fore tibia 15 μm ; of mid tibia 33 μm ; of hind tibia 38 μm . Hind tibial comb with 12 setae. Lengths and proportions of legs as in Table 3.

Table 3. Lengths (in μm) and proportions of legs segments of male *Nanocladius* (*Nanocladius*) *tamabicolor* Sasa

	Fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	BV	SV	BR
p ₁	340	425	280	235	160	95	65	0.66	1.9	2.7	1.0
p ₂	330	310	160	95	75	35	50	0.47	3.3	4.2	3.0
P3	350	430	245	145	105	85	60	0.57	2.6	3.2	1.5



Figures 6–8. *Nanocladius* (*Nanocladius*) *tamabicolor* Sasa, Male imago. 6. Wing; 7. Hypopygium, dorsal view; 8. Hypopygium, ventral view.

Hypopygium (Figs. 7, 8). Anal point bare with pointed apex, without setae at base. Anal point 30 μm long, basal wide 5 μm , peak pointed. Laterosternite IX with three setae. Transverse sternapodeme medially convex, with weak oral projection. Gonocoxite 130 μm long, with 6–8 long setae. Gonostylus 63 μm long, apical strongly hooked and with 1 long seta. Megaseta 10 μm long. HR 2.1, HV 2.4.

Distribution. This species occurs in Japan, Russian Far East, Korea (Palearctic Region).

Remarks. Based on the examination of holotype material, the characters were consistent with the original description. Besides, some additional characters should be added as: total length / wing length 1.6. Wing length / length of profemur 2.9. Tentorium 138 μm long, 13 μm wide. Dorsocentrals 7, scutellars 2. VR 1.3. Costa extension 70 μm long. Palpomeres length (in μm): –, 45, 68, 88, 118. Palpomere 2 and 3 ellipsoid, 4 and 5 long and slender, Palpomeres 5/3 ratio: 1.7. Anal point 30 μm long, basal wide 5 μm , peak pointed. Transverse sternapodeme with weak oral projection. Gonocoxite 130 μm long. Gonostylus 63 μm long, apical strongly hooked and with two long setae. Megaseta 10 μm long. HR 2.1, HV 2.4.

Key to males of *Nanocladius* Kieffer from East Asia

1. Genae not or scarcely excavated; either pulvilli absent or scutellum with more than 6 setae 2
- Genae clearly excavated; pulvilli present and well developed; scutellum with 2–6, usually 2 setae 3
2. AR 0.34, anal point present *N. (P.) asiaticus* Hayashi
- AR 1.33–1.63, anal point absent *N. (P.) shigaensis* Inoue, Komori, Kobayashi, Kondo, Ueno & Takamura
3. Inferior volsella typically triangular, apex narrow pointed 4
- Inferior volsella almost triangular or rounded, apex rounded or nearly at right angle 12
4. Tergites I–IV and VII–VIII without setae, tergites V, VI with 4, 6 setae respectively
..... *N. (N.) calvatus* Fu & Wang
- All tergites with setae, tergites I–VIII each with more than 6 setae 5
5. AR about 1.15, laterosternite IX with about 5 setae *N. (N.) crassicornus* Sæther
- AR less than 0.9; laterosternite IX with 2–3 setae 6
6. LR_1 less than or equal to 0.45 *N. (N.) oyaberadiata* Sasa, Kawai & Ueno
- LR_1 more than or equal to 0.55 7
7. Transverse sternapodeme without oral projection, anal point short and not exceed the posterior margin of tergite IX *N. (N.) pubescens* Makarchenko & Makarchenko
- Transverse sternapodeme with oral projection, anal point long and exceeding the posterior margin of tergite IX 8
8. Femur of mid- and hind legs yellowish brown in basal 1/2. Tergites I–VI brown or dark brown with pale yellow margins, setae of tergites VI–V clustered *N. (N.) taiwanensis* Fu & Wang
- Body including legs and tergites all in uniform color, setae of tergites IV–V row in line or evenly dispersed 9
9. AR 0.42–0.57, more setae on median of tergites, and fewer setae on both margins 10
- AR more than 0.6, few setae on median of tergites, and more setae on both margins 12
10. Inferior volsella acute-angled triangle, gonostylus straight *N. (N.) tokuokasia* (Sasa)
- Inferior volsella posterior margin hooked, gonostylus curved apically *N. (N.) spiniplenus* Sæther
11. AR 0.71–0.92, setae of tergites with distinct pale circular hair-root *N. (N.) rectinervis* (Kieffer)
- AR 0.66–0.76, setae of tergites without distinct pale circular hair-root *N. (N.) balticus* (Palmén) Sæther
12. Anal point short and with a wide base, not exceeding the posterior margin of tergite IX 13
- Anal point long and with a narrow base, distinctly exceeding the posterior margin of tergite IX 14

13. AR 0.44–0.52, transverse sternapodeme without oral projection, apex of gonostylus slightly expanded *N. (N.) baltus* Fu & Wang
- AR 1.52–1.7, transverse sternapodeme with oral projection, apex of gonostylus obviously expanded *N. (N.) palpideminutus* Makarchenko & Makarchenko
14. Tergites setae irregularly double on all tergites *N. (N.) dichromus* (Kieffer)
- Tergites setae in single row at least on 3 tergites 15
15. Gonostylus hooked, with narrow apex 16
- Gonostylus straight and slightly curved, apex same width to base 17
16. AR 0.8, inferior volsella rounded *N. (N.) tamabicolor* Sasa
- AR 0.32–0.42, inferior volsella almost triangular *N. (N.) trinus* Fu & Wang
17. Inferior volsella downward extended, LR₁ 0.40, transverse sternapodeme with undeveloped oral projection *N. (N.) jintuquardecima* (Sasa)
- Inferior volsella laterally extended, LR₁ 0.59–0.66, transverse sternapodeme with obviously oral projection 18
18. AR 0.92–1.04; tergite I with 8–18 setae, tergites II–VIII with 11–30 setae; squama with more than 3 setae *N. (N.) distinctus* (Mall.)
- AR 0.47–0.63; tergite I with 3–11 setae, tergites II–VIII with 6–19 setae; squama bare or with 2 setae 19
19. Tergite IX with 3–5, 4 setae, squama with 2 setae *N. (N.) minimus* Sæther
- Tergite IX with 7 setae, squama bare *N. (N.) seiryufegia* Sasa

Conclusions

All *Nanocladius* species uniformly have either a bare anal point or a few microtrichia at the base, and generally they have some stronger setae above the base. According to the holotype of *N. (P.) asiaticus*, it has a common anal point while it lacks an anal point in the original description. Only *Nanocladius (P.) shigaensis* described by Inoue *et al.* 2015 without an anal point within the genus *Nanocladius*. Another character is that the arrangement of setae on tergites show some differences among different species, and setae of tergites always have a distinct pale circular hair-root.

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